USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

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Title: Application of wireless and sensor technologies for urban water quality management

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Principal Investigators: Arnold, William Alan; Hondzo, Miki; Hozalski, Raymond; Novak, Paige (University of Minnesota)

Collaborator: Capel, Paul (USGS)

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Abstract: The water quality of streams draining watersheds has been degraded by increasing urbanization. The general symptoms of this degradation include more frequent large flow events, reduction in channel complexity, reduced retention of natural organic matter, and elevated concentrations of nutrients. Newly emerging urban water quality threats, including insecticides, herbicides, pharmaceuticals, and estrogens, are known or suspected to damage the health of humans and ecosystems. The restoration and management of streams have traditionally attempted to improve the hydrological and water quality conditions in-stream or in riparian zones. Recent studies have indicated the portion of a watershed covered by impervious surfaces and connected to the stream by stormwater drainage is the primary degrading process of stream ecology and health. These findings suggest that the sustainable restoration and management of stream water quality require quantification of hydrological, chemical, biological, and geomorphological processes, and that these processes must be assessed across a range of scales. Furthermore, interactions among biogeochemical processes across watersheds are

either non-linear processes or linear processes dependent on non-linear drivers. The monitoring of such a system inherently requires a change in traditional field sampling strategies. We propose to transform traditional and very limited (in terms of spatial and temporal resolution) field measurements through the integration of multi-scale, spatially-dense, high frequency, real-time, and event-driven observations by a wireless network with embedded networked sensing.

The goals of the proposed research are to assess the benefits of stormwater best management practices in mitigating the pollutant loads from urban and peri-urban sources, to evaluate the effectiveness of traditional grab sampling in calculating pollutant loads, and to develop correlations to predict the concentrations of non-sensed chemical or biological pollutants. These goals will be achieved by establishing a wireless sensor network capable of monitoring fundamental water quality parameters at high spatial and temporal resolution. It is hypothesized that sensed fundamental water quality parameters can be used for predicting the presence of emerging chemical contaminants in urban streams. It is also hypothesized that the water quality in streams draining similar impervious urban areas is controlled by the mean and variance of effective stormwater residence time. The mean and variance of water residence time, the time it takes urban runoff to travel between the impervious urban land and a receiving aquatic body, will be characterized by radio frequency identification technology (RFID), which will augment the proposed wireless network. Ultimately, data generated from such a monitoring network will enable mechanistically-based scaling and forecasting of water quality in urban streams and rivers. This will transform urban planning practices and management of water quality in streams draining urban land.
